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ADDITIONS TO KANSAS MAMMALIA.

By M. V. B. Knox, of Baldwin City.

2a. Lynx rufus, var. maculatus, Horsfield and Vigors. Texas Wild Cat. Less frequent than L. rufus.

39. ———. Mouse, taken near Baldwin; not yet identified.

62. Sorex ———. Taken at Coal Creek, 1873, by C. K. Jones.

63. Hesperomys Nuttalli, Harlan. Red Mouse. In Col. Goss' museum, Neosho Falls. Taken at Colony, March 7, 1873, by J. J. Fairbanks.

64. Arvicola pinetorum, LeC. Taken near Baldwin City, 1876.

65. Perognathus flavus, Baird. Taken at Nickerson, Reno county, May, 1876.

66. Blarina talpoides, Gapper. Taken at Baldwin City, by Geo. Cheney, April 6, 1877.

THE INFLUENCE OF FOOD-SELECTION UPON THE EVOLUTION OF ANIMAL LIFE.

By Dr. A. H. Thompson, Topeka, Kansas.

The influence that food-selection exercises in directing the course of the development of animal life, is a factor of the principle of evolution that has scarcely received the attention at the hands of naturalists and physiologists that its importance deserves. Its potency is manifested in such a marked manner as to be, under some circumstances, a prime factor in the determination of great changes in the phenomena of animal life, even of catastrophes, and yet it has been relegated by most philosophic biologists, when recognized at all, to a second or third place in the order of forces. Many are the theories that have been woven and elaborated in regard to the origin and evolution of life, in the name of the developmental principle, and many are the factors that go to make up the argument in favor of each one. But in the table of forces acknowledged, direct, indirect and accidental, food-selection rarely finds a place under any name, and is still more rarely reckoned as more than an accidental influence.

By the term food-selection we designate that power which each particular substance used as food exercises in causing certain species of animals to employ it for sustenance; i. e., it directs the choice of animals towards itself for sufficient reasons to induce them to use it for food, such as convenience, adaptability, etc. If a given species in a certain district be surrounded by a constant supply of its proper food, it is drawn towards it, employs it, and lives;—the food-environment favors life. But it may not be thus permanent and favorable to the perpetuation of a certain stage in the life of a species. In fact, it rarely is so, but may be changeful and inconstant. In this case, the food imposes upon the animal organization employing it, the necessity of ever changing in conformity to the new conditions ever being presented. The power of food to induce change in the animal organism, and maintain or alter it at its own caprices, is the selection which dictates change.

The dependence of animals for life upon the food-supply, is the most apparent fact of their existence. Every process of their physiology, the movement of every muscle, the production of every bone or other tissue, the action of every gland or nerve-cell, the wonderful processes or origin, growth and reproduction, depend for their maintenance and success upon the completeness of the nutritial supply. Nutriment for the tissues, the mysterious pabulum that upholds life, is derived from the food eaten, and consequent upon the acquisition of food is the continuance of life with all its phenomena, as well of the species as of the individual. All animal life, throughout all time, has been thus dependent, and the variation of the quantity or quality of food has caused some modification of all the forms that ever lived upon the earth. Its importance as a potent modifying influence can scarcely be over-estimated, and is, perhaps, second only to cosmical influences in the potency of its effects upon animal life. The pursuit and procurement of food is the one occupation of all animals; their one object in life being the obtaining of it, that life may be maintained and transmitted. Much force is expended by animals in the augmentation of the species, and success in this depends altogether upon the completeness of the food-supply, and its proper assimilation. One of the first indications of insufficiency of food among all animals, man included, is decrease of reproduction.

This paramount dependence of the animal organism upon food, necessitates the adaptation of the organs of the economy that procure, reduce and assimilate it for the nutrition of the tissues, to the kind of food employed. Upon this proposition rests the theory of this paper, i. e., that through the necessity of food to animals, modification necessary to adaptation to the food used has taken place, and that through this adaptive modification extensive differentiation of animal structure has obtained, through the multiplicity of food-changes.

Given the presence of food, the first important function, the first action, indeed, performed by the animal in its procurement, is prehension—the seizing and conveying of the food to the organs of mastication and deglutition. The organs exercising this function are of wonderful variety, but in each species are specially adapted to the kind of food employed. In Mammalia, for instance, the organs of prehension are especially the lips of the mouth. but which are further assisted in many species by other organs, as in Bimana, Quadrumana, Rodentia, and Marsupialia, by the fore limbs; in the elephant, by the proboscis; in the tapir, by the snout; in the ant-eater and giraffe, by the tongue, etc.; and are supplemented, usually, by the teeth, for more forcible seizure and retention.

The next function performed, is mastication. This is effected by the teeth, with their supporting environments—the jaws, muscles, etc. This region is, perhaps, the most readily susceptible to food-changes, and the influence of food-selection. It is the gate-way to the economy upon which the entire alimentary system depends for the nutrient substances that maintain life. It is the set of millstones through which all food must pass, and by which all food must be reduced into digestible form. The masticating region is the most variable of the entire organism, and presents more variety, taken throughout the whole animal world, than any other special region of the economy. The cause of this mutability of structure we assume to be due to the influence of food-selection, exercising its power in modifying the parts with which the food comes so forcibly in contact, on entering the animal system. The masticating apparatus must be adapted, preeminently, to the food employed, for upon the adjustment to the work of reducing it, everything depends. Modification and re-modification in conformity to food-changes is a constant law of the being and uselessness of this region; and this has indeed obtained through the long ages, until the contemporary result in our own time is a wonderful variety of forms of masticating apparatus. This is the work of food-selection—a conformity of tools to material, not of food to organs.

In the further observation of the animal organization, we find the same adaption. Throughout the length of the alimentary canal, in the deglutition, digestion, solution and assimilation of food; in all the processes whereby the food used is converted into nutrient pabulum for the support of the life and growth of the tissues, evolution has performed the work of perfect conformation of the organs to the food as employed. As evidence in point, we may note the difference between the stomach of a ruminant and a carnivore, employing highly specialized forms of extensive classes for examples. In the ruminant the many compartments into which the stomach is divided, the lengthy intestine, and the complicated process necessary for the elaborate digestion and solution of vegetable food, is in marked contrast to the simple stomach and alimentary system of the carnivore, whose food (being animal tissue already converted from the vegetable) requires the merest dissolving preparatory to absorption and assimilation. In the ruminant the long intestine presents an extensive absorbing surface to the slowly-dissolving bolus of vegetable tissue; while in the carnivore, the intestine is short, as absorption of its food is chiefly performed in the stomach, and a long intestine is useless. This is in keeping with the fact that animal food is chiefly dissolved and absorbed in the sac of the stomach, and vegetable, starchy foods are acted upon and absorbed in the intestine. In omnivorous animals, as man, for a mixed diet we find a mixed capacity, while in vegetable feeders and carnivora of all grades, these organs are adapted to the food used.

But let us glance at some other forms as peculiarly adapted to their food, as employed, and the apparent causes for modification.

Taking Rodentia, we find the peculiar feature of the order to be the two strong, curved, cutting, continuously-growing incisors, which are undoubtedly so modified for a purpose. The origin of these specialized teeth must have been the accidental preference of nuts and barks of trees, which induced a variation and developed the peculiar organs, with accompanying modification of the remainder of the denture and of the digestive region. Many of the members of this order became climbers, to obtain their food more readily, and some species took up their abode in the trunks of trees, living an arboreal life convenient to their food, and protected by the plants that bore it. Some of them became burrowers, in order to obtain roots and barks in the ground and the small grains of low plants, and their burrowing habits soon developed their chief protection against their enemies, many of them becoming so completely adapted in their limbs to this work as to be almost incapable of progression upon level ground.

In Bradypus, we find a peculiar adjustment of the curious teeth to the mere crushing of the leaves and shoots of trees, and a remarkable conformation of the stomach to this coarse food, it being divided into compartments by transverse ligatures for the longer retention of food for digestion. But a most peculiar feature in these animals is their adaption to an almost complete arboreal life, by the legs being modified for the suspension of the body beneath the limbs of trees, and its living and moving continually in this position. This peculiarity we claim to be one of the indirect results of food-selection.

In the giraffe we observe another leaf-eater, whose limbs are modified for a terrestrial existence, while it is enabled to reach the branches of trees by means of elongated neck and legs, these having been developed by a preference for the shoots and buds of trees.

In the Carnivora we find strong jaws with strong muscles for the exercise of great power in seizing and tearing prey; also a lithe, elastic and powerful systemic framework, for pursuing and overcoming other animals. As their food requires no mastication, there is no lateral movements of the jaws, in the purest forms, but these are merely capable of extensive opening and forcible closure. In the vegetable-feeder, on the contrary, the lateral movement capacity of the jaws is largely developed to allow of trituration, while extensive and forcible vertical movement is suppressed. The claws of Felidæ may also be reckoned as the product of food-selection, being developed and used in the capturing and tearing of prey.

A remarkable instance of evidence in our favor is found in some of the Cetacea. Balænidæ are noted for the absence of teeth, which are superseded by rows of baleen or whalebone, which fringes the opening of the mouth, and by means of which small sea-animals (chiefly Pteropoda), its food, are strained from the water. This adaption to this food is comparatively recent, as numerous rudimentary teeth are found in the jaws in early fœtal life, evidencing a former condition in which teeth were possessed and used upon different food. The usurpation of these organs by a peculiar growth that is better adapted to the food which plentifully surrounds these animals, indicates a rapid and wonderful power of modification by food-selection. The animal also possesses a very small œsophagus, to guard against the entrance of larger food which has not been reduced for want of teeth.

We are reminded here of an opposite example of a disproportionate power of deglutition—that of ophidia. In these reptiles, the food, often disproportionately large, is swallowed by permission of the articulation of the inferior maxillary and its attachments, which part and separate to a remarkable extent to allow the large object to pass. The denture is formed for seizure and gradual creeping up upon the victim.

But we cannot go into further minutiæ. We have thus glanced at some of the more specialized forms which furnish most marked evidence; but the adaption of form to food is just as perfect in all other species.

As has been already stated, other conditions being in harmony, the persistence of the food-supply will induce and determine the permanence of a given species or genus. The preservation of many species through long geological ages must, in many cases, be due to this law; but the opposite condition of the rapid changing of food, fitful and inconstant conditions, the rapid succession of extremes, will necessarily destroy life, and cause the extinction of a species depending upon it. The mean condition of slow, persistent deviation will cause modification and adaptation of structure, and consequent preservation of life. Almost any species can tolerate a very slight alteration of its food with little inconvenience; and a persistence of the change, inducing a tendency in a certain direction, will inevitably bring its appropriate modification of animal structure, through the simple law of adaptation of form to environments. Food being an important environment of every animal, change in its conditions must enforce change upon the animals depending upon it. Food-selection acting as a persistent, moulding force upon a mutable recipient, the animal organism, the result of its influence in every movement must be alteration of the organism towards the direction of least resistance. This direction of change must be the one of conformation to the new condition, and adaptation to the new characteristics of the food as presented.

Every species must be capable of converting all food into nutriment that lies within a certain range and limit, and the widening of this limit is a comparatively easy operation. Its extension in a certain direction and contraction in another will, by a continual succession of such movements, bring a total and complete change of form. Branching, deviation by a few groups of members of a species in different directions, may give rise to different forms, and in time become established as forever separate species.

The factors that enter the arena as active causes of the phenomena of changes in the all-potent food environment, are numerous and variable. In the vegetable world, upon which all animals depend for their food either directly or indirectly, the causes inducing its variation as a food are legion; and in the present state of our knowledge very few are even partially understood. There are forces and inter-forces, acting variously and erratically, so that in the main we can comprehend but little of their workings.

Cosmical influences have determined the quantity and quality and the main characteristics of the plant world from the beginning, and through it of the animal world. In the earliest history of the earth, when it was just sufficiently cooled from its cosmical fusion to be habitable for the earliest forms, these were such forms and manifestations of life as the conditions induced and permitted. The meager and lowly-organized animal life was moulded to and subsisted upon the vegetable life which was its cotemporary. This plant life existed undoubtedly—indeed, must have existed—in order to make animal life possible, as the latter unquestionably depended from its genesis upon the plant life coexisting, even though they may have been evolved simultaneously from the primary protoplasmic substance which is the mysterious basis and origin of all organic life. Food-selection, at the first, touched the shadowy, unknown beginnings of life; and has, from its very threshold, held all life in its powerful embrace, molding it as the sculptor does his clay!

Whatever the subtle influences may be, so mysterious yet so potent and forceful—be it peculiarities of soil or air, inconstancy of the methods of fertilization, fortune or misfortune in the struggle for existence—whatever the quiet, irresistible force may be that induces a change in the quantity or quality of a plant as a food for a species of animal, when the change comes the animal must change with it or perish. Suppose a peculiar quality is developed in a plant in a particular locality, and the animal there making it its habitual food prefers the change and follows it closely. Preference leads to habit, variation is begun, natural selection seizes the new tendency, and by the power of food-selection modifies the animal economy to the new food. The same species in another locality may have its food suffer from some influence so as to cause deterioration and become unfit for use, and compel it to adopt a nearly allied plant. This plant having previously been but occasionally used for food, its entire adoption would cause some change in the animal organism, and a variation in a certain direction. Again, a class of plants may develop a peculiar flavor, possibly due to the influence of insect fertilization, and a certain animal in a certain locality being compelled to use this plant, or that may prefer the change, may adopt the new form and become conformed to it as it evolves peculiar characteristics. Accidental preference for single parts of the plant, as the leaves, buds or tender shoots, or nuts, fruits, flowers, roots, bark, etc., leads to habitual employment of the parts and consequent modification of structure, both special and general.

It is not possible to name or describe one completely understood process in this intricate system, but these crude suggestions may direct observation of the principles at work. The subject is so massive, yet so new and unworked, that little can be expected of attempt at elaboration for this paper.

But we will close by reference to one animal upon which food-selection has wrought marked effects, and whose development has been largely influenced by it. I refer to Homo sylvaticus (man). With the appearance of the opposable thumb in man, the era of the teeth as prehensile organs began to decline, until today that function in them is entirely aborted. With the beginning of the artificial reduction of his food from its natural condition dates the great catalogue of changes in his organism, one of the most conspicuous and important of which is the reduction of the masticating region. The art of cooking his food came with intellectual evolution. The brain case increased as the face was suppressed, till to-day it greatly predominates in the contour of the head. The artificial reduction of food has induced a tendency toward the suppression of the teeth and their environments, and in the highest races we find a marked atrophy of this region. We claim that this is due to the softening of food, which has caused mastication to fall lergely into disuse, and that the masticating organs not being employed, or being of no further use to the economy, must, according to law, submit to the doom of useless things, and be expelled. We thus contend that the teeth of man are tending toward final abortion on account of their chief function, mastication, rapidly becoming useless. Like all other organs, they require the stimulus of use to endure their perpetuation in the species, and like all organs that have become useless through altered habits of the species, must be suppressed through the law of economy of growth. As evidence that the tendency is in progress, we may cite the atrophy of the masticating region in the highest races, as compared with its size and strength in the savage, i. e., the smaller muscular development, jaw-bones, teeth, etc. Also in the wisdom-tooth we are the contemporary witnesses of an organ in process of suppression—a very remarkable and interesting phenomenon. This tooth in civilized man to-day is rarely perfect in size or structure; it is usually atrophied, often markedly so; is always inferior in structure to the other teeth in the same denture; is often erupted very late in life and in some persons never appears; or again, only one or two in the set of four may erupt. This tooth, originally, as in most savage tribes to-day, was the peer of the other molars in quality and usefulness, but in civilized man it is frequently worse than useless on account of the disturbance it frequently occasions by mal-eruption.

The food of man is itself undergoing evolution, and the era of its scientific production is fast approaching. This is progressing at such a rate and with such a tendency, that its ultimate result will be the chemical preparation of the proximate elements of the tissues, which will be used as food alone. The resources of nature are beginning to be felt to be inadequate to meet the demands of the increasing millions of the race for food. Science must come to the rescue, and will produce from inorganic as well as organic nature the compact and simple proximate elements of the tissues, upon which, in the time to come, the race will doubtless depend for food. In this form food will require little manipulation preparatory to assimilation, and our species will have reached the highest pinnacle of life when possessing the least animality; and this chiefly by the power of food-selection!